U-13 ENHANCED SEPTIC SYSTEMS

PRACTICE AT A GLANCE

Over 25% percent of the homes in the Bay watershed rely on septic systems to treat their wastewater. These systems discharge about 8.3 million pounds or 3.4% of the total nitrogen load to the Bay each year.

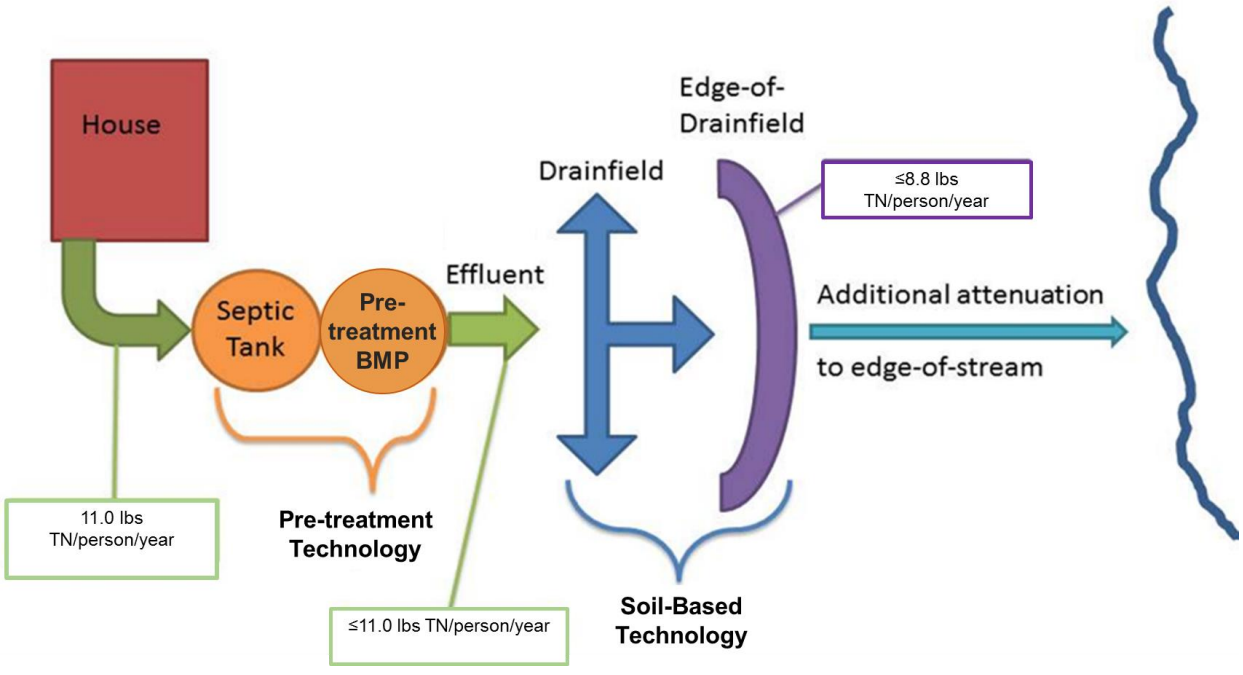
Pre-treatment technologies (ex situ) treat wastewater before it reaches the drainfield. Soil-based (in situ) technologies enhance the performance within the drainfield.

No phosphorus credit is available because research shows that soils are very effective at retaining phosphorus from septic systems.

Nitrogen reductions are also available when septic systems are pumped-out, or when they are connected to the sanitary sewer system.

DESCRIPTION

The typical septic system treats waste in two steps: within the septic tank and in the drainfield. Enhanced onsite treatment systems can boost nitrogen removal in septic systems using pre-treatment and soil-based technologies, as shown below.



Schematic of a residential septic system with pre-treatment and soil-based BMPs

Pre-treatment technologies use a mix of biological and physical processes to improve settling and denitrification within the septic tank to reduce the amount of nitrogen discharged to the drainfield.

Soil-based technologies improve drainfield conditions to increase denitrification and attenuation within the soil.

There are many different types of enhanced septic systems. The expert panel defined nutrient removal credits for a variety of non-proprietary practices. Proprietary practices, those developed, marketed, and constructed by a manufacturer, should undergo third-party testing and be approved by the appropriate state agency prior to receiving nutrient reduction credit.

Pre-treatment and soil based technologies may be combined to maximize nitrogen removal performance. No phosphorus reduction credit is available for these practices.

Septic system pump-outs can provide a 5% nitrogen reduction, but can only be reported once every 5 years for any particular system. **Disconnecting septic systems** by tying them into the sewer system is another BMP that moves the entire septic system nutrient load to a wastewater treatment plant.

OTHER BENEFITS OF FLOATING TREATMENT WETLANDS

Installing enhanced septic systems can provide several benefits beyond improved nitrogen removal:

- Improve bacteria removal
- Reduce septic system overflows and leaks
- Improved property values

WHERE TO FIND THE BEST OPPORTUNITIES IN YOUR COMMUNITY

Some form of enhancement can be implemented on any home served by a traditional septic system. Many homes have older systems that owners may be looking to replace or upgrade. High density areas where a large number of onsite systems do not meet nutrient removal standards are good opportunities and could potentially be grouped into cluster systems, reducing the cost of upgrades for individual homeowners. Another opportunity for upgrades is during a home sale, when the performance of the system is inspected.

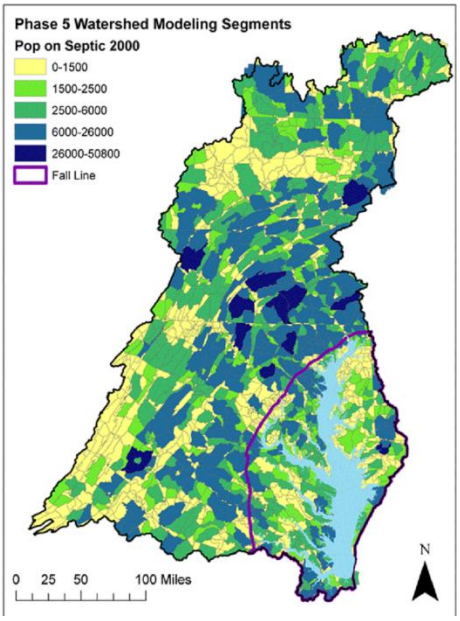
Example of pre-treatment system during installation

You can also target specific areas to maximize the impact of a system enhancement. Homes on septic systems that are within 1,000 feet of surface waters are a good place to start. Septic systems located in sandy soils are another good opportunity because coarse soils naturally filter less nitrogen and would benefit most from a septic system enhancement.

Areas with high background levels of groundwater nitrates are another place to consider septic system enhancements.

HOW TO GET STARTED

Conduct an inventory of your existing septic systems. An initial desktop analysis would help prioritize future site inspections and could review:



Population on septic systems in the Chesapeake Bay watershed

- Board of health records that identify clusters of failing systems
- Geographic information system (GIS) data
- Population density information
- System proximity to the Chesapeake Bay, its tributaries, or other sensitive water bodies.

In the absence of good onsite system records, areas with onsite systems can be mapped by overlaying locations of centralized sewers on a tax assessor's map. Any developed properties not adjacent to the existing sewer lines are likely served by onsite septic systems.

It is also useful to have an onsite septic systems management plan in place that considers the age and density of your existing septic systems while also accounting for future growth and development. The county health department and the local planning agencies should work together to identify the most important program elements in regulating and planning future onsite systems.

Also, be sure to research the technologies available to your community. If you have the resources, you could hire an expert or commissioning a team to evaluate the most appropriate technologies for your area. A list of approved enhanced septic systems for each state is available in the Resources section.

GENERAL COST INFORMATION

As with any BMP, the cost of implementing an enhanced septic system varies based on the type of technology used and the site selected for implementation. Most of the cost is often incurred by the homeowner, but there may be subsidies or technical assistance available from the state or local government.

Costs for enhanced septic systems can be generally broken into a) installation, and b) operation and maintenance costs, including electricity. Many states offer incentive programs to help offset the installation cost. For example, the Pennsylvania Infrastructure Investment Authority (PENNVEST) Homeowner Septic Program offers special loans to either replace a septic system or connect to the sanitary sewer system. Maryland's Bay Restoration Fund provides grant assistance to cover up to 100% of the installation cost to eligible property owners looking to upgrade their systems. Other states offer loan programs for homeowners to repair or replace failing septic systems.

Table 1 shows a summary breakdown of cost information for several technologies approved by the expert panel. Information on state-specific septic system enhancement programs are in the Resources section.

Table 1. Estimated Septic System Technology Costs

System	Installation	Electrical	O&M	60-yr PV LCC*
Septic tank	**$3,500** ($2,800-4,200)	**0**	**$90** ($70-110)	**$6,700** ($5,400-8,000)
Activated Sludge	**$9,000** ($8,000-10,000)	**$100** ($80-120)	**$560** ($450-670)	**$33,500** ($27,000-40,000)
Recirculating Media Filters	**$16,500** ($13,000-20,000)	**$10** ($8-12)	**$750** ($600-900)	**$43,500** ($35,000-52,000)
Conventional	**$5,750** ($4,600-6,900)	**0**	**$300** ($200-400)	**$16,500** ($15,000-18,000)
Low-Pressure Dispersal	**$11,500** ($9,000-14,000)	**$25** ($20-30)	**$670** ($540-800)	**$36,000** ($29,000-43,000)
Drip	**$10,150** ($8,300-12,000)	**$15** ($12-18)	**$620** ($500-740)	**$32,500** ($26,000-39,000)

*Present Value Life-Cycle Cost
Courtesy: www.werf.org/decentralizedcost

COMPUTING THE POLLUTANT REMOVAL CREDIT

The pollutant removal of pretreatment and soil-based technologies are calculated differently. Pretreatment systems are evaluated based on the reduction of nitrogen from a baseline of 11.0 lbs N/person/year *before* it reaches the drainfield, while soil-based systems are evaluated based on their ability to reduce the Edge of Drainfield load below a baseline of 8.8 lbs/person/year.

The efficiency (%) for **Pre-treatment** technologies is calculated by the following equation:

$$E_{Ex-Situ} = 100 \times \frac{(11.0 - L_{Eff})}{11.0}$$

Where:

$E_{Ex\text{-}Situ}$ = Pretreatment Removal (%)
L_{Eff} = Effluent Nitrogen Load after Pretreatment practice (lbs/person/year)

The efficiency (%) for **Soil-based** technologies is calculated by the following equation:

$$E_{In-Situ} = 100 \times \frac{(8.8 - L_{EDF})}{8.8}$$

Where:

$E_{In\text{-}Situ}$ = Soil-based Removal (%)
L_{EDF} = Edge of Drainfield Nitrogen Load (lbs/person/year)

The resulting efficiency values from combining pretreatment and soil-based technologies is shown in Table 2.

Table 2. Summary of Nitrogen Load Reductions from Pretreatment and Soil-based Enhanced Septic System Technologies.

Pre-Treatment Technologies		Soil-Based Technologies	
Certified Secondary Treatment Systems	20%	Shallow-Placed Pressure-Dosed Dispersal	38%
Intermittent (Single Pass) Media Filters	20%	Elevated Sand Mounds	38%
Subsurface Constructed Wetlands	20%	Permeable Reactive Barriers	varies
Recirculating Media Filters	50%		
Integrated Fixed-Film Activated Sludge System	50%		
*Pre-treatment and soil-based technologies can be combined to earn a greater reduction.			

HOW TO REPORT THE PRACTICE TO THE STATE

The following data reporting requirements are recommended for Enhanced Septic Systems:

- Practice Name (ex. NSF 40 with Shallow Pressure Dispersal)
- Location of the system in latitude/longitude
- Year the system was installed

WHAT IS REQUIRED TO VERIFY THE PRACTICE OVER TIME

Verification of enhanced septic systems is state-specific. In general, regular inspection and maintenance by a certified service provider is recommended. Annual inspections are encouraged for some technologies, while others, such as the enhanced conventional systems, can be less frequent.

The expert panel recommends the following sample checklist for annual inspections of an NSF Standard 40 Class I system. Similar checklists are available for each BMP in the expert panel report.

- Check pumps and blowers for proper operation. Clean filters, add lubrication as required.
- Check the sludge depth in the aeration zone and clarifier, and pump out if needed.
- Follow the manufacturer's instructions for O&M for additional detail.
- Conduct other generic O&M procedures as needed (measure sludge/scum levels in septic tank, pump septic tank as needed, clean effluent screen/filter, walk drainfield, etc.).

RESOURCES

Type of Resource	Title of Resource	Web link
Expert Panel Report	Recommendations of the On-Site Wastewater Treatment Systems Nitrogen Reduction Technology Expert Review Panel (2014)	http://chesapeakestormwater.net/wp-content/uploads/dlm_uploads/2014/10/owts_expert_panel_final_report_02-17-14.pdf
Expert Panel Report	Nutrient Attenuation in Chesapeake Bay Watershed Onsite Wastewater Treatment Systems (2016)	http://www.chesapeakebay.net/channel_files/24265/draft_final_report_nutrient_attenuation_in_onsite_systems_8-31-16.pdf
Archived Webcast	Crediting On-Site Wastewater Treatment Systems in the Bay Watershed (2014)	http://chesapeakestormwater.net/events/crediting-on-site-wastewater-treatment-systems-bay-tmdl/
EPA Resource	A Mode Program for Onsite Management in the Chesapeake Bay Watershed (2013)	http://executiveorder.chesapeakebay.net/130627_Ches_Bay_Tech_Assist_Manual.pdf
EPA Resource	Planning for Septic Systems (2015)	https://www.epa.gov/sites/production/files/2015-06/documents/2004_07_07_septics_planning_for_septic_systems.pdf
Approved Technologies	Advanced Technology for Onsite Treatment of Wastewater, Products Approved by State (2017)	https://www.epa.gov/septic/advanced-technology-onsite-treatment-wastewater-products-approved-state
State Program	Delaware Septic Rehabilitation Loan Program	http://www.dnrec.delaware.gov/fab/Pages/Septic-rehabilitation-loan-program.aspx
State Program	Maryland Bay Restoration Fund	http://www.mde.state.md.us/programs/Water/BayRestorationFund/OnsiteDisposalSystems/Pages/index.aspx
State Program	PENNVEST Homeowner Septic Program	http://www.phfa.org/programs/pennvest.aspx
State Program	Virginia Clean Water Financing and Assistance Program	http://www.deq.virginia.gov/Portals/0/DEQ/Water/NonpointSource/DEQ%20SepticSmart%20Week.pdf

State Program	West Virginia On-Site Systems Loan Program	http://wvhdf.com/home-buyers/seasoned-home-buyers/septic-system-improvement-loan
Other Resources	Mapping Onsite Treatment Needs, Pollution Risks, and Management Options Using GIS (2004)	http://www.ndwrcdp.org/documents/WU-HT-01-17/WUHT0117_post.pdf